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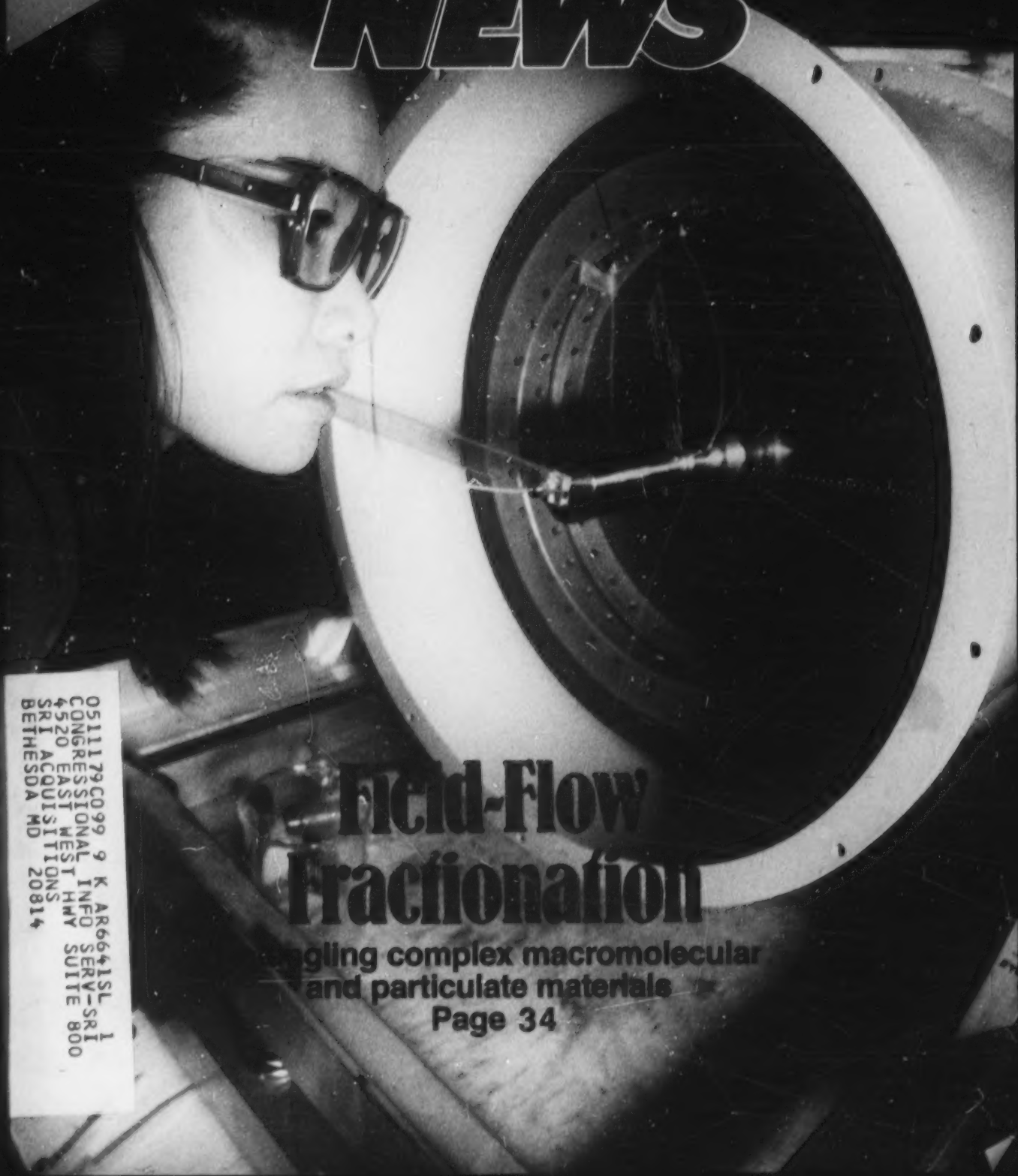
OCTOBER 10, 1988

CHEMICAL & ENGINEERING

NEWS

Scientific news from the Los Angeles ACS meeting



Field-Flow Fractionation

Juggling complex macromolecular and particulate materials

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CHEMICAL & ENGINEERING NEWS

Volume 66, Number 41
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OCTOBER 10, 1988

News of the Week

■ **The space shuttle *Discovery* was a big success—revamped components passed their first flight tests, and scientific experiments went off smoothly.** Page 4

■ **Congress just got under the wire in passing the remainder of its 1989 appropriation bills.** Page 5

■ **McGraw-Hill's *Chemical Week* magazine has been sold to a U.K.-U.S. investor team.** Page 5

■ **General Motors has launched a nationwide science education program for primary and secondary schools based on solar-powered car.** Page 5

■ **Congressional study of current methods for detecting pesticide residues offers suggestions for improvements.** Page 6

Business

SCI medalist Vincent Gregory recalls his years at Rohm & Haas, voices concerns about the chemical industry; the strong Canadian uranium industry is getting stronger; the U.S. uranium industry continues in doldrums; plastics composites industry will record its fourth straight year of growth in 1988. **Page 9**

Government

Upcoming election won't bring any big changes in makeup of the Congressional committees that oversee science issues. **Page 18**

Science

From the Los Angeles meeting: chemists closing in on synthesis of taxol, a scarce natural product with potent anticancer activity; first dinitrogen complex of an f-element synthesized; novel technique for studying solid-state reactivity developed. **Page 22**

Education

New study says knowledge of science among precollege students is generally lower than levels found in initial 1969 survey; from the Los Angeles meeting: ACS program takes science to elementary school students. **Page 25**

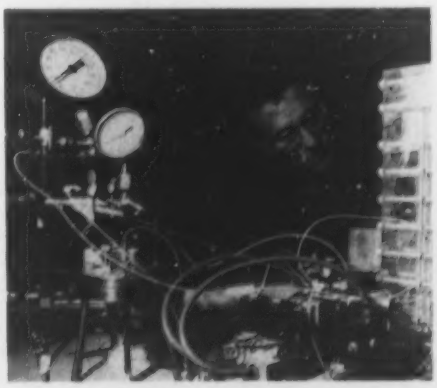
Technology

The Los Angeles meeting continued: new hydroformylation catalysts have as much as 100 times the activity of previous ones; chemical sensors find growing use in microanalysis; technical and economic progress made in direct coal liquefaction. **Page 27**

ACS News

Scenes from Los Angeles meeting, which offered participants a variety of activities, captured on film by C&EN's roving photographer. **Page 46**

Cover: Centrifuge used for sedimentation field-flow fractionation studies at University of Utah is examined by researcher Kim Ratanathanawongs. Channel in which FFF takes place, which extends around the circumference of the centrifuge basket, is located between the silver-colored rings. Photo by Alexis Kelner



Special Report

Field-flow fractionation provides a versatile array of methods for separating the components of complex macromolecular and particulate materials, while also characterizing separated components. Page 34

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LETTERS

Fluoridation of water

SIR: I congratulate you and your staff, particularly Bette Hileman, on the special report "Fluoridation of Water" (C&EN, Aug. 1, page 26). The article is, to me, a manifestation of the ultimate essence of what the American Chemical Society can be at its very best. The article addresses within the specifics of fluoridation a number of fundameatal issues that confront and confound scientists and the public alike in endeavors to resolve societal issues involving science and technology. It is a case study that displays fundamental issues that I and many others endeavor to address in general terms. Some of these issues are:

- The distinction between a goal (to improve dental health) and a technological mechanism (fluoridation of water) to pursue that goal.
- The potential for misadventure (unbalanced research programs, selective use of data, biased analyses of data, sequestering of data, restriction of publication, and misdirection of research funds in general) of designing research programs to support a specific political position on a technological option as compared to designing research programs to further the attainment of a goal.
- The potential conflict of roles of an individual as a scientist (an expert) and as an advocate of a technological option related to the field of expertise.
- The role of value judgments in the selection and implementation of a technological option (mechanism) to address a societal issue.

The report has not been written as a case study, but the elements of a case study are there.

Anna J. Harrison
Mount Holyoke College

SIR: In the special report on fluoridation of water, the author says, "For 43 years, there seems to have been no middle ground between the two points of view [for and against fluoridation]. She aiso quotes a Natural Resources Defense Council attorney, "Neither side has given the other one rational moment."

This is the equal-time approach favored by television commentators to attract viewers to programs where science is confronted by opponents, such as programs on biotechnology or on creationism. Equal time for what? Unfortunately, antifluoridationists, like other detractors of science, are unrestrained by adherence to veracity, so that science loses ground. The allegation that sponsors of fluoridation have not given their opponents one rational moment is quite false.

I, and many others, have tried for many years to rebut—rationally—factual misrepresentation by antifluoridationists. For example, in 1980, they made a statement in an official pamphlet sent to all Oakland, Calif., area voters, that the National Academy of Sciences (NAS) stated that "fluoride is not an essential nutrient, therefore deficiency is impossible." At my instigation, this statement was declared untrue by the president of NAS. Actually, NAS, in "Recommended Daily Allowances" (1980) said, "Fluorine can be considered an essential element for the growing organism on the basis of its proven beneficial effects on dental health....The Food and Nutrition Board recommends fluoridation of public water supplies where it is needed because of low natural fluoride levels."

The deplorable special report contains many questionable statements against fluoridation that need a lengthy rebuttal.

Thomas H. Jukes
University of California, Berkeley

SIR: I was disappointed and dismayed by your recent article and editorial on the fluoridation of water. This biased and misleading review in my professional journal is very disturbing.

Although it can be argued that there are two sides to any scientific question, it is totally inappropriate to emphasize an essentially discredited position, especially when the great majority of these antifluoride data has been questioned by peer review. The length of the article (17 pages) and the complete distortion in the quality, quantity, and sophistication of the scientific data do great disservice to the American Chemical Society and cast grave doubt on your scientific judgment.

There is no conspiracy to withhold the truth about fluoridation, because there is no scientific case to support the antifluoridation position—a case that is based largely on philosophical and emotional issues.

This article, not peer-reviewed, should not be permitted to suggest in any manner that it reflects the position of ACS. Action must be taken immediately to rectify the appearance that this is an ACS official position.

The dental associations should be commended for their support of fluoridation, despite the political and economic pressures that they have experienced. Despite the economic impact that fluoride has had on the dental profes-

Canadian uranium industry growing stronger

U.S. uranium producers may not much like the idea of competing with Canadian uranium producers in the U.S. and world markets, but they can't help but admire the strength with which their Canadian counterparts can play the game.

The Canadian uranium industry is the world's leading uranium producer and exporter. It produces about $820 million (U.S. dollars; $1.00 U.S. = $1.22 Canadian) worth of material per year and exports about 85% of it.

To the chagrin of their competitors, Canadian uranium producers have been doing this for years. Now several recent developments figure to make them even more formidable competitors. One is a new policy on nonresident ownership in the Canadian uranium mining sector.

Another is the merger of Saskatchewan-owned Saskatchewan Mining Development Corp. (SMDC) with Eldorado Nuclear Ltd., owned by the federal government, to form a new, world-class integrated uranium mining and processing company. The Canadian government owns 38.5% and the Saskatchewan government owns 61.5% of the new company called Cameco—Canadian Mining & Energy Corp. The eventual goal is to privatize the company.

Another development that is certain to help Canadian uranium producers is the Canada-U.S. free trade agreement. The agreement, signed on Jan. 2, 1988, has been passed by the U.S. Congress, but is being held up by opposition parties in the Canadian Senate. The federal election Prime Minister Brian Mulroney has called for next month likely will determine the fate of the agreement in Canada. The election is slated for Nov. 21.

The free trade pact is very important to the future of the Canadian uranium industry, says Richard M. Williams. Williams, a uranium adviser in the Uranium & Nuclear Energy Branch of Energy, Mines & Resources Canada, notes that the U.S. is Canada's largest uranium customer, accounting for more than one third of total exports. Canadian uranium producers supplied more than 40% of U.S. domestic requirements last year. Canada, in fact, is the largest single source of uranium for U.S. utilities.

The free trade agreement benefits both Canada and the U.S., Williams told a recent Uranium Seminar, sponsored by the U.S. Council for Energy Awareness (USCEA) in Tucson. He was careful not to say that it benefits the "U.S. uranium industry." For Canada, the agreement ensures that Canadian producers won't be hit by restrictions prohibiting foreign uranium from being enriched in the U.S. Canadian producers will remain exempt, too, from any import restrictions that may be imposed in the U.S. by new legislation.

For the U.S., says Williams, the pact means that U.S. utilities will have access to Canadian uranium, even when Canada may be in short supply and in a mood to limit exports. Under the agreement, Canada also has agreed to exempt the U.S. from the Canadian Uranium Upgrading Policy.

This means that U.S. refiners and converters will be able to compete for the job of converting—that is, upgrading—Canadian uranium exported to the U.S., either to be consumed or transformed for shipment to third countries. Normally, Canadian uranium has to be upgraded in Canada before it leaves the country. As a result of the agreement, says Williams, U.S. companies could compete for the refining and conversion business associated with about 70% of Canada's uranium exports.

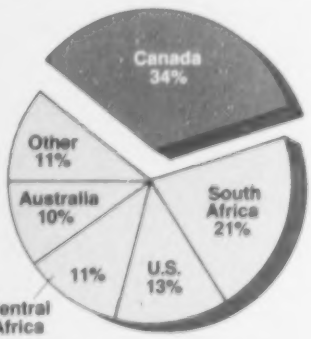
Representatives of U.S. uranium companies in the audience were less than impressed. Their industry has been declared "nonviable" by the U.S. Secretary of Energy for three successive years. Most of them fought the free trade pact's uranium provisions every step of the way. And most of them still want some kind of restrictions imposed on uranium imports.

Williams, however, questions such proposals. He notes that the U.S. uranium industry had been protected by a Department of Energy restriction on enriching foreign uranium that was imposed in 1967. This 100% embargo lasted 10 years and was not completely phased out until 1984.

Williams says that this restriction "totally disrupted the international uranium market and contributed to ... significant overcapacity in the U.S." Much of that overcapacity, he adds, has since been proven to be uneconomic.

Meanwhile, competitors will have to contend with Cameco, the integrated company with $1.2 billion (U.S.) in assets. In the privatization of the company, the provincial and federal governments' shareholdings will be reduced 30% within two

Canada leads western world in output of uranium

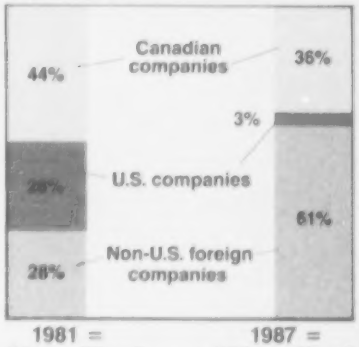


1987 U_3O_8 production = 13.0 million lb

Source: Canadian Mining & Energy Corp.

Non-U.S. foreign firms are big in Canadian uranium

Canadian uranium exploration expenditures



1981 = $115 million[a] | 1987 = $30.3 million[a]

[a] U.S. dollars, $1.00 = $1.22 Canadian

Source: Uranium & Nuclear Energy Branch, Energy, Mines & Resources Canada

Most of Canada's uranium is exported

Uranium shipments[a] = 10,020 metric tons

a Average annual scheduled deliveries (as of mid-1987) for the five-year period 1987–91.
Source: Uranium & Nuclear Energy Branch, Energy, Mines & Resources Canada

years, 60% in four years, and will disappear in seven years. No individual Canadian will be able to own more than 25% of the voting rights and no individual non-Canadian will be able to own more than 5%. Total non-Canadian shareholdings will be restricted to no more than 20% of the votes cast at shareholder meetings.

This year, says company vice chairman R. E. (Roy) Lloyd, Cameco will supply about 16% of the western world's uranium from its three operating mines (Key Lake, Rabbit Lake, and Cluff Lake). A fourth mine —at Cigar Lake—now is in what Lloyd calls "the predevelopment stage."

According to Lloyd, the Cigar Lake property, discovered in 1981, is the largest high-grade uranium deposit in the world. "The potential of this deposit cannot be exaggerated," he says.

Lloyd figures that Cameco will control 40% of Canada's known, economic uranium resources. It also will operate Canada's only uranium processing plants at Blind River and Port Hope, Ontario.

Meanwhile, Canada's new foreign ownership policy, it is hoped, will lure more foreign investment dollars into the Canadian uranium industry. When it was announced by the Minister of State for Forestry & Mines late last year, its primary objective was to make sure that Canadians owned 51% of an individual uranium property when production begins.

However, says EMR's Williams, the government would allow lower levels of Canadian ownership "if Canadian control can be clearly demonstrated." Only when Canadian partners cannot be found would the government consider exemptions to these ruies. And these exemptions would require cabinet approval.

Despite these limitations, Williams says the new foreign ownership policy gives both foreign and domestic investors considerably more flexibility than they had under the old policy. The first foreign taker under the new policy is Korea Electric Power Corp., which bought a 2% nonvoting interest in (now Cameco's) Cigar Lake uranium project.

Foreign, but not U.S., companies are heavily involved in Canadian uranium exploration. Last year, says Williams, non-U.S. foreign companies accounted for more than 60% of the money spent to look for uranium in Canada. Although the dollar figures are less [only $30.3 million (U.S.) total last year], that non-U.S. foreign share is up from only 28% in 1981.

U.S. companies' interest in exploring for Canadian uranium has waned. Their share of exploration spending has dropped from 28% in 1981 to 3% last year. Most of that money came from U.S. oil companies. However, Williams believes that, if the free trade agreement is given the green light, it, along with Canada's new foreign ownership policy, could rekindle the interest of U.S. companies in Canadian uranium.

That remains to be seen. What is certain is that, at the end of last year, Canada estimated its uranium resources stood at a hefty 1.23 billion lb. This represents what can be recovered at about $112 per lb. Almost half of those resources are much less costly to mine.

A mushrooming spot market drove average Canadian export prices for uranium down to $23 per lb as U_3O_8 last year. Few producers in other countries are able to survive at that price level.

Earl Anderson

U.S. uranium industry still in trouble

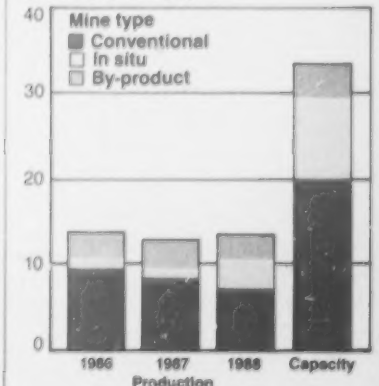
The Secretary of Energy has declared the U.S. uranium mining and milling industry to be "nonviable" for three successive years, 1984–86. He no doubt will declare that it was nonviable again in 1987.

As utilities have turned away from nuclear power, uranium prices have nosedived. Low demand and low prices have taken their toll. Over the past five years or so, the mining and milling industry, or at least some firms in it, has been fighting to get help from the government, through the courts and through legislation. So far, without luck.

The industry's hardship helped trigger more than a little cynicism at the recent Uranium Seminar sponsored by the U.S. Council for Energy Awareness in Tucson, Ariz. Ludwig W. Koch, a principal in Uranium Consulting Services (Atlanta), notes that the U.S. uranium industry has shrunk to one fourth the size that it was 10 years ago and that it has become "a ward of all three branches of our federal government."

The federal courts, he says, are being asked to impose an embargo on foreign uranium to raise prices and sales (the Supreme Court recently threw out that request). Congress, adds Koch, is being asked to enact a guaranteed buying program

Uranium output is small shadow of capacity



Source: Freeport Uranium Recovery Co.

Plastics composites use continues to grow

The U.S. plastics composites industry continues to do well, according to figures from the Composites Institute of the Society of the Plastics Industry. With 1988 being the fourth year in a row of growth for the industry, shipments this year are projected to approach 2.7 billion lb, 6.3% more than in 1987, based on performance in the first two quarters of 1988.

"The continued growth in composites shipments during the first half of this year is all the more significant coming off such a strong 1987," says Carl. C. Rue, chairman of the Composites Institute and vice president for corporate planning and development with CertainTeed Corp. In 1987, shipments reached a record 2.54 billion lb, an unexpected 11% increase over 1986. Although 1987 was a record year, shipments are already expected to total 1.39 billion lb in the first six months of this year.

Polymer-based composite materials, including reinforced thermoset and thermoplastic resin composites, reinforcements, fillers, and polymer concrete, have applications in a wide variety of industries; the transportation industry is the largest share of the market at 25% (670 million lb), and the marine and construction industries follow closely, each at 19% (about 500 million lb).

The marine industry at 21% and the aircraft, aerospace, and military sector at 12% are leading the demand growth for composites in 1988. All nine market sectors are showing some degree of growth, although the levels vary widely between a low of 0.6% for the construction industry to a high of 21% for the marine industry.

Transportation as the largest consumer of composites at 25% (670 million lb) also has a low level of growth at 2%. Future growth in the use of composites in this area is expected, especially in the auto industry, which is the single largest segment of the transportation market. Rue points out that the Big Three U.S. auto makers—Chrysler, Ford, and General Motors—have recently established a joint research consortium for the study of the applications of polymer-based composites in the auto industry. It is hoped that this study will lead to an increased use of composites in the auto industry.

The marine industry has grown most steadily in its share of the market over the past three years. Composites shipments to the marine industry are expected to increase 3% from 1987, thus finishing 1988 at a level of 19% of the market. Other areas such as appliances and business (151 million lb), consumer products (173 million lb), and electrical and electronics (224 million lb) continue to be strong with shipments growing about the same rate as the overall composites market.

The use of light, high-strength, reinforced materials is expected to continue in designs in the aircraft, aerospace, and military sector. If advanced aircraft systems are brought into production, many of which consist of more than 80% composite materials, shipments to this industry are expected to rise for many years from the present level of 41 million lb. Since 1988 is an election year, prospects for this market hinge on the election results and defense policy in the near future.

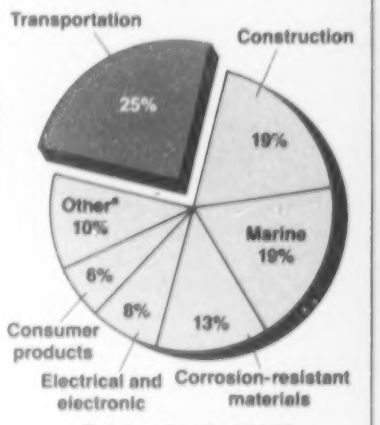
The growth in the use of corrosion-resistant composites has been tied closely to production in other industrial areas. Capacity or near-capacity production in the chemicals and petrochemicals areas has accelerated the demand for replacement parts, pipes, and tanks and has caused the market to grow from 291 million lb in 1986 to a projected 345 million lb in 1988.

Production of some composites, such as those using glass fibers, may be limited by the production capabilities of the necessary intermediates. Demand for glass fibers is currently being met through debottlenecking efforts and near-capacity production, according to Rue. Chemical intermediates also may be in short supply. However, Rue says that supply problems might soon be easing.

Forecasts for quantities of composites shipments in the last two quarters of 1988 show little change from the first two quarters, with 1988 expected to finish at record levels.

Ann Thayer

Transportation takes big share of composites



Total estimated 1988 shipments = 2.70 billion lb

a Includes appliances, aircraft, aerospace, and military. Source: Composites Institute, Society of the Plastics Industry

Marine uses of composites show fastest growth

Millions of lb	1988[a]	1987	1986	Change 1987–88
Aerospace and military	40.8	36.4	37.0	12.1%
Appliances and business	151.3	140.5	137.0	7.7
Construction	506.8	506.0	456.0	0.6
Consumer products	173.0	166.5	149.0	3.9
Corrosion-resistant equipment	345.0	329.0	291.0	4.9
Electrical and electronic	224.0	214.0	201.0	4.5
Marine	500.0	412.6	340.0	21.2
Transportation	670.0	656.0	585.0	2.1
Other	82.6	75.3	83.0	9.7
TOTAL	2695.5	2536.3	2279.0	6.3%

a Based on six-month estimates and projections for the remainder of the year. Source: Composites Institute, Society of the Plastics Industry